STATEMENT OF WORK

FOR

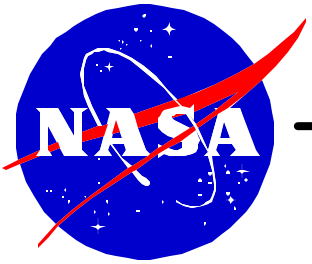
THE GLAST

MISSION OPERATIONS CENTER

AND

MISSION OPERATIONS SUPPORT

May 1, 2003



GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

Statement of Work

for

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May 1, 2003

NASA Goddard Space Flight Center

Greenbelt, Maryland

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1. INTRODUCTION

This Statement of Work specifies the tasks to be performed and approach to be used by the contractor to implement the Mission Operations Center (MOC) and provide lead flight operations support for the Gamma-ray Large Area Space Telescope (GLAST) mission.

NASA Goddard Space Flight Center (GSFC) is partnering with the Department of Energy (DOE), NASA Marshall Space Flight Center, Stanford University's Linear Accelerator Center (SLAC), Stanford University, the Naval Research Laboratory, University of California, Santa Cruz, the University of Alabama, and several foreign partners to perform the GLAST mission. The instruments aboard the observatory will detect and investigate the direction, energy, and arrival time of gamma rays and gamma ray burst events. They are the Large Area Telescope (LAT), being provided by SLAC, and the GLAST Burst Monitor (GBM), being provided by NASA MSFC. GSFC has the responsibility for overall project management, including procuring the spacecraft, instruments, and supporting services to meet the mission requirements.

GLAST is scheduled for launch in September 2006 from the Cape Canaveral Air Force Station aboard an Expendable Launch Vehicle. It will be nominally placed in a 550 km circular orbit at a 28^{o} inclination. The nominal mission life for GLAST is 5 years, with a goal of 10 years. The GLAST MOC will be located at the NASA Goddard Space Flight Center in Greenbelt, MD.

2. GENERAL DESCRIPTION OF WORK

2.1 Overview

The MOC is the primary link between the ground-receive sites and the science community, as described in the GLAST Mission Operations Concept Document 433-OPS-0001. Figure 1 shows the major system interfaces for GLAST. Under this contract, the contractor shall perform two major functions, MOC implementation before launch, and mission operations for 14 months after launch (60-day L&EO period plus one year normal operations).

The development activities include the design, implementation, and verification of the MOC. Design activities include requirements analysis and definition, system level trade studies, and creation of a working architecture that meets all requirements. Implementation activities include setup of requisite equipment, installation of appropriate software builds and upgrades, and configuration management of all hardware and software components. Verification activities include unit and component level testing, MOC system level testing and simulations, and mission level compatibility and end-to-end testing.

The operations activities include preparation, execution and reporting of all planning and scheduling, real-time, post-pass processing functions of the MOC. Preparation activities include validation of contractor and government provided processes and procedures, spacecraft training of contractor personnel, MOC training of other team members, and assisting the government in

the acceptance of components provided by other GLAST team members. The primary purpose of the real-time support is the monitoring of the health and safety of the observatory, execution of pre-defined contingency operations, and fault isolation and recovery in the event of an unforeseen circumstance. Real-time activities include all communications to and from the GLAST observatory and distribution of the appropriate data to the other team members within allocated requirements. Post-pass activities include receiving and distributing play-back of science data from ground stations, prompt analysis of engineering data, and producing and maintaining trend data for the observatory and ground system performance. It is expected that the operations personnel will actively support both the spacecraft and observatory level I&T testing activities.

Both the development and operations functions require programmatic support such as review attendance/participation, documentation delivery, and schedule development and maintenance.

The contractor shall provide all necessary personnel, materials, and equipment, except as otherwise provided herein, to support the work requirements under this contract. The government shall provide the necessary facility and supporting infrastructure (e.g., power, lighting, access to an external time source, and furniture) since the MOC will be physically located at NASA Goddard Space Flight Center.

2.2 Applicable Documents

The following documents provide information on mission requirements and concepts that apply to this effort:

- GLAST Science Requirements Document
- GLAST Mission Systems Specification
- GLAST Ground System Requirements Document
- GLAST Mission Operations Concept Document

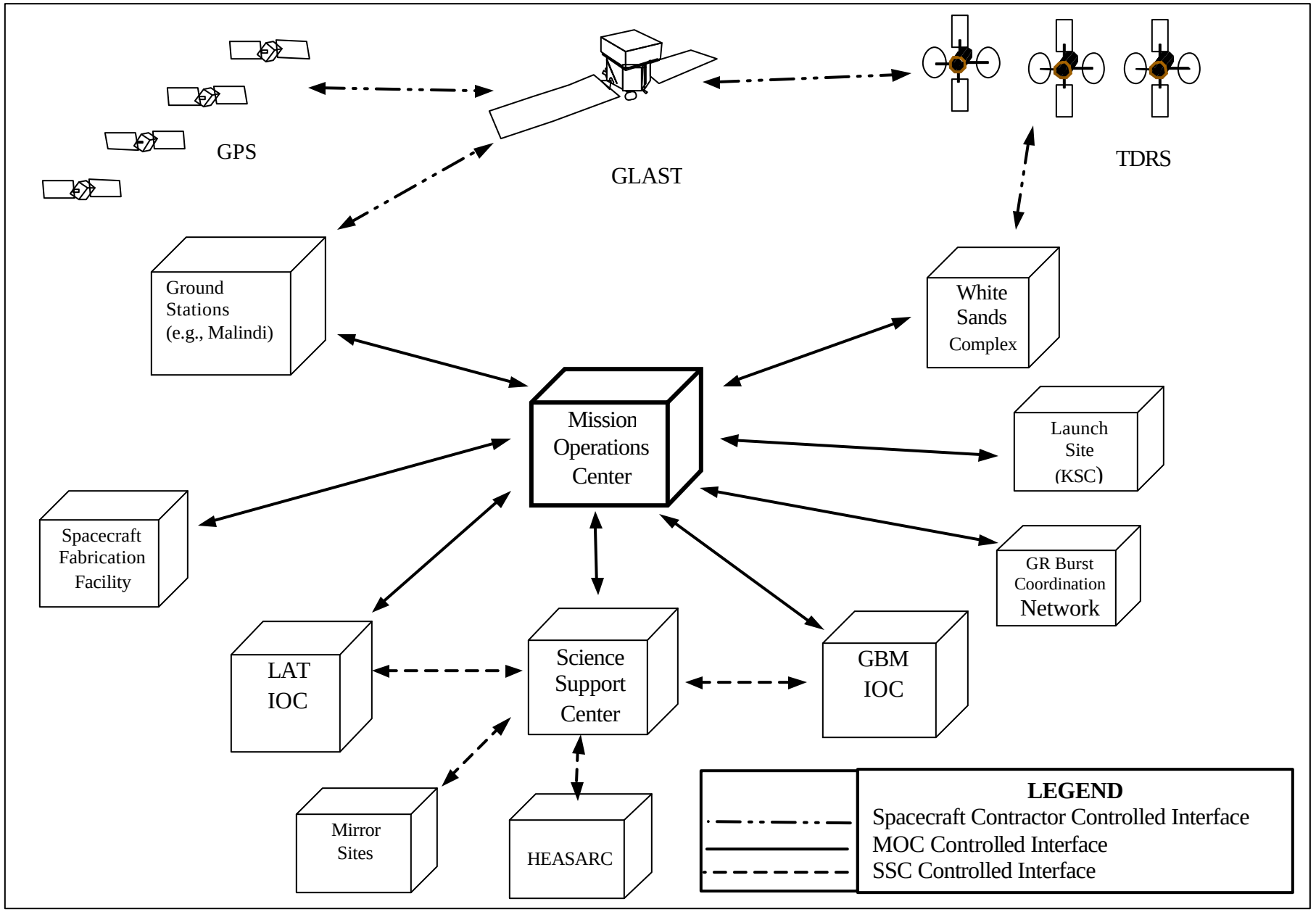

Figure 1 - GLAST System Interfaces

3. MOC DEVELOPMENT SERVICES

The contractor shall implement a MOC system that meets:

- the MOC-related requirements specified in the GLAST Science Requirements Document, Mission Systems Specification, Ground System Requirements Document, and Ground System Mission Assurance Requirements Document,
- the interfaces specified in the relevant MOC Interface Control Documents, and
- the operations concepts described in the Mission Operations Concept Document.

This effort involves requirements analysis, design, software implementation, hardware acquisition and installation, and system testing.

The contractor shall provide the appropriate hardware and software environment to support the development effort at the contractor's facility.

The contractor shall develop a MOC Development Plan, which defines the overall implementation approach, including the team organization, requirements verification process, development/release schedule, development metrics for evaluating progress, documentation plan, configuration management plan, and software management plan.

3.1 Requirements and Design

The contractor shall support the GLAST Project in the maintenance of ground system Level 3 requirements and the updating of the Mission Operations Concept Document. The contractor shall support the Project in the presentation of these concepts and requirements at the Ground System Requirements Review. The contractor shall develop and document a set of detailed Level 4 MOC functional and performance requirements based on these and other applicable Project documents.

Based on the requirements and operations concepts, the contractor shall develop the MOC design. This shall include both the hardware and software designs, as well as the detailed definition of all external MOC interfaces. The contractor shall analyze and determine which requirements will be met with existing government and commercial off-the-shelf software tools and which will require new software or modifications to existing software. The contractor shall also define and document any modifications that are needed to the off-the-shelf tools.

The contractor shall present the MOC design and interface definitions at the Ground System Preliminary and Critical Design Reviews, and shall document the design in a MOC Design Specification.

3.2 Implementation and Test

The contractor shall develop the software needed to augment the off-the-shelf software tools, and integrate the complete set of software into one software system. This shall also include acquiring and installing the appropriate hardware needed to support the software.

The contractor shall perform unit and system-level testing to verify the functionality and performance of the system.

The contractor shall deliver the MOC system in a series of releases, with each release providing an incremental set of capabilities. The capabilities planned for each release shall be documented in the MOC Development Plan. Each release shall be demonstrated to the government, and the government shall accept a release based on an assessment of how well it satisfies planned capabilities. The contractor shall ensure that capabilities are provided when needed to support the various ground readiness and operations test activities. The contractor shall ensure that the MOC is ready to support launch and meets all requirements by April 15, 2006 (ORR – 3 months).

For each release the contractor shall deliver the source code, other supporting software (e.g., scripts), and supporting release documentation to the government in electronic form via a mutually agreed upon media (e.g., CD).

The contractor shall install a subset of the MOC system at the spacecraft contractor facility to be used for interface and operations testing support. This system is expected to primarily consist of two to three workstations hosting the MOC command and control software, and some minimal network and peripheral support hardware. The contractor shall return this hardware to the MOC facility at Goddard some time after the 60-day L&EO period, unless the government and contractor mutually agree that the hardware should stay at the spacecraft contractor facility. The contractor shall thus not depend on the return of this hardware to satisfy MOC requirements.

3.3 System Maintenance

The contractor shall maintain the MOC system software, hardware, and documentation to ensure reliability, maintainability and operability, along with the environments, emulators, and test software necessary to develop and verify these systems throughout the lifetime of the observatory. The contractor shall retain expertise in all products and procedures necessary to maintain the ground system software after the on-orbit acceptance period. The contractor shall retain all ground system software and documentation for the complete life cycle, development through the end of the mission. This documentation will be used for maintenance of the system and shall be accessible to the government until the end of the mission.

The government will provide the physical facility at Goddard, located at or near the MOC facility, to support system maintenance. The contractor shall provide the required hardware and software to support maintenance.

3.4 Government-Furnished Hardware Maintenance

The contractor shall integrate and administrate the government-furnished hardware provided to support the MOC. This currently includes the spacecraft simulators provided by the spacecraft vendor. This hardware and the supporting operating systems will be standard commercially available products. The contractor will not be responsible for maintaining the application software on these systems, nor any non-standard system software or hardware components that are not commercially available off-the-shelf.

3.5 MOC Interface Testing

The contractor shall conduct the interface tests necessary to verify ground system compliance with external interface requirements. The external interfaces to the MOC include but are not limited to NASA's Space Network, any mission required RF Ground Station(s) and their associate return paths, the spacecraft manufacturer's facility, the Science Support Center, the LAT Instrument Operations Center, the GBM Instrument Operations Center, the Gamma-ray Coordinates Network, and launch site ground systems. The contractor shall verify MOC outputs, format, and contents, directly with the external interfaces or with simulator(s) and ground system equipment provided by the government. The contractor shall work closely with NASA mission engineers to perform communications, command, control, and operational requirements trade analyses. The contractor shall provide all necessary interfaces to the ground command, control and data system. This is to include all necessary system documentation, interface control documents, databases and test efforts.

3.6 Ground Readiness Testing

Ground Testing verifies the functionality, performance, and interface compatibility of the overall ground system. This testing will be led by the government and will be accomplished via a series of Ground Readiness Tests (GRT)'s that collectively validate the ability of the ground system to meet requirements and support operations. The tests are performed with the coordination and participation of the individual ground system elements, and nominally are supported via the use of simulators and prerecorded data. The contractor shall provide information necessary to define and execute these tests, such as command and telemetry databases, ground system procedures, and expected results from the MOC perspective. The contractor shall support the execution and evaluation of the tests. The schedule and content of these tests will be defined in a Ground System Test Plan. The tests will begin and end approximately a year and 9 months and 5 months before launch, respectively.

3.7 End-to-End Testing

End-to-End System Tests are the series of operations-oriented ground system tests conducted with the actual observatory (spacecraft and instruments). The observatory will be at the spacecraft vendor facility, and tests will be conducted with the MOC systems either co-located with the spacecraft or located in the MOC facility at Goddard, depending on the timeframe and test goals. The purpose of the tests is to confirm compatibility between the observatory and the MOC, as well as the other ground system elements connected to the MOC (e.g., SSC, IOC's and GCN). These tests will also be used to conduct the operations exercises/simulations that cannot be adequately performed on the observatory simulators. These tests will occur during the spacecraft and observatory I&T periods and will be completed approximately 2 months before launch.

The contractor shall take the lead in determining the purpose and goals of each of the tests, coordinating efforts with the government, spacecraft contractor, and instrument teams. The contractor shall document these tests in an operations Mission Operations Readiness Plan or other comparable document. The contractor shall lead the conduct and evaluation of the tests,

recognizing that the spacecraft contractor must approve all actions (commanding) with the spacecraft before they can be used in test.

To accomplish any given test, the contractor shall perform the following activities:

- Devise the test goals and requirements.
- Schedule the test and coordinate resources.
- Conduct all subsystem reviews of the commands, telemetry monitors, procedures, scripts, contingency plans, etc., to be used during the test.
- Conduct a final script review prior to each test.
- Execute the planned command procedures and generate supporting data products during the test.
- Identify, document and resolve anomalies that were encountered during the test.
- Obtain and process all supporting data into a post-test report.

All of the End-to-End Test activities shall be coordinated with the government, spacecraft contractor, and instrument teams, as appropriate. The government, in consultation with the contractor and other test participants, will make the ultimate decision on the success or failure of each test.

3.8 Configuration Management

The contractor shall maintain configuration control over all software and hardware to be used in the MOC, and shall document the plan in a MOC Configuration Management Plan. The contractor shall implement a configuration management system to support the configuration management requirements.

4. MOC OPERATIONS SERVICES

The contractor shall perform all routine, pre-planned, and nominal activities required to successfully operate the GLAST mission. The contractor shall provide costs for operations support through the first year of the mission (60-day L&EO period plus 12 months of normal operations).

4.1 Pre-Launch Operations Readiness Activities

Before launch the contractor shall participate and, in certain cases lead, a variety of activities that collectively ensure the ability to operate the mission. This includes support for both the early orbit/activation phase (first 60 days of the mission) and normal operations. Generally the activities are focused on ensuring that the people (operations team), operations products, and operations processes are ready for launch.

The contractor shall perform these activities using MOC systems co-located at the spacecraft I&T facility and located in the MOC facility at Goddard. The activities that occur at the spacecraft facility will occur during spacecraft and observatory I&T. The contractor shall work closely with the spacecraft vendor during I&T to ensure that opportunities to perform operations-related test and validation activities with the MOC systems at the spacecraft facility are maximized.

4.1.1 Operations Readiness Testing

Operations Readiness Testing includes those exercises, simulations, and rehearsals used to prepare the operations staff for launch, checkout, science mission activities and contingency operations. It is also used to validate the various operations products and processes planned to be used in operations. Operations Readiness Tests will be conducted either from the MOC systems co-located at the spacecraft facility or from the MOC facility at Goddard, as appropriate. Generally it is required that launch rehearsals be conducted at the actual MOC facility. These tests will utilize simulators wherever possible, but certain activities will require use of the spacecraft.

The contractor shall provide the lead role in the performance of the exercises, simulations and rehearsals required for a successful launch and mission. For those that involve the spacecraft, the contractor shall coordinate closely with the spacecraft contractor, who must approve any activities that involve commanding the spacecraft or instruments. To accomplish these activities the contractor shall:

- devise the goals and resource requirements;
- schedule the activity based on resource constraints;
- conduct reviews of planned activity with participants;
- execute the activity and collect appropriate data;
- create post activity report to document results;
- resolve anomalies; and
- incorporate lessons learned into future activities

The contractor shall document the plan, approach and schedule for the Operations Readiness Testing in a Mission Operations Readiness Plan.

4.1.1.1 Operations Exercises

This testing is performed at the subsystem level. It involves relatively few engineering and MOC operations staff. These tests are used to show that a particular command, command procedure, or command sequence produces the desired result. These tests occur on a daily or weekly time scale. These tests may last from an hourly to daily duration. The contractor shall develop all command sequences, procedures, and scripts and submit them for review to the government or other mission elements as required.

4.1.1.2 Mission Simulations

This testing is performed at the system level and typically involves multiple space and ground elements except the launch site. The simulations can involve a large number of engineering and operations staff. These simulations are based on the results of the exercises described above. Generally the goal is to utilize the simulators whenever possible to minimize demands on spacecraft access time.

4.1.1.3 Launch Rehearsals

This testing is performed with all individuals who will participate in the launch in their launch day positions. These events will require significant advanced planning, review and coordination. The contractor shall provide launch support for launch simulations and rehearsals. This effort encompasses the conduct, analyses, and evaluation of pre-launch training and simulations of the launch (through orbit insertion). There will be at least two rehearsals with the launch site. The contractor shall provide all personnel who will participate in the launch for these events.

4.1.2 Operations Product Development and Validation

The contractor shall develop and validate the various operations products that are needed for mission operations support. These include but are not limited to telemetry and command databases, executable command procedures, and display and configuration monitor definitions. The contractor shall develop these products where appropriate based on the inputs provided by the spacecraft and instrument vendor teams. As an example, the spacecraft contractor will provide a set of written procedures that describe how each subsystem will be initially activated and checked out after launch. The contractor shall develop the associated command procedures, solicit approval from the spacecraft contractor, and then, with assistance from the spacecraft contractor, perform the validation of all the procedures.

Validation of the various operations products shall be performed during the Operations Readiness Testing activities discussed above. The operations product validation process shall be performed primarily with the spacecraft or instruments whenever possible and appropriate, and with the simulators at other times. All products shall be initially verified with a simulator before they are used with the spacecraft or instruments.

The contractor shall provide configuration management support for the operations products, such as the telemetry and command Project Data Base and command procs. The contractor shall provide a system that supports this configuration management process.

4.1.3 Training

The contractor shall provide MOC training to other personnel who will need to use the MOC system for operations support. This primarily includes Project (government), spacecraft contractor and instrument operations team personnel.

The contractor shall support the spacecraft training provided by GLAST spacecraft provider. The contractor shall support instrument training provide by the instrument teams.

The contractor shall provide fully qualified personnel to perform the GLAST mission. This includes certification of operations personnel based on a training and certification plan.

4.2 On-Orbit Operations Support

The contractor shall provide on-orbit mission operations support. This shall include but not be limited to all of the following:

- scheduling upcoming Ground Station and TDRS support;
- commanding the observatory in real time;
- monitoring the real time observatory housekeeping telemetry and ground station status data;
- receiving playbacks of high rate telemetry data from the Ground Stations;
- sending level 0 processed science data to the SSC, the LAT IOC and the GBM IOC;
- performing off line analysis on the housekeeping and ground system data to determine trends in the observatory and ground system performance;
- up-linking stored memory loads as needed;
- managing changes to observatory flight software;
- managing changes to the observatory databases;
- managing burst alert processing;
- responding to Targets of Opportunity;
- archiving housekeeping and ground system data;
- performing orbit determination and clock correlation;
- ensuring that the spacecraft is brought back to operational functionality in the case of any observatory anomaly or emergency.

The contractor shall support the activities related to the government's acceptance of the spacecraft from the vendor within the first 60 days of the mission, and the subsequent operations responsibility handover of the spacecraft to the Code 444 Space Science Operations Project at NASA Goddard.

The contractor shall assume full maintenance responsibilities for the telemetry and command database after the 60-day spacecraft checkout period. Up until this time period the contractor will have shared this responsibility with the spacecraft contractor and instrument teams.

The contractor shall provide primary observatory subsystem engineering support to augment the sustaining engineering support being provided by the spacecraft and instrument vendors. For this support, the contractor shall provide and maintain operations personnel who are knowledgeable of the design and performance of the subsystems, and the methods for trending and analyzing performance.

The contractor shall provide sustaining engineering support for the MOC hardware and software systems.

The contractor shall generate a Sustaining Engineering Plan that describes the approach and process for maintaining the observatory, MOC software and MOC hardware.

5. PROGRAMMATIC SERVICES

5.1 Reviews

The contractor shall generally support all GLAST mission-level reviews as requested by the government, and specifically support the ground system reviews discussed below. The contractor shall also conduct Monthly Status Reviews with the government.

5.1.1 Ground System Reviews

The contractor shall support the government in conducting the ground system reviews listed below. Currently scheduled dates are provided for planning purposes.

- System Requirements Review (SRR) – July 2003
- Preliminary Design Review (PDR) – December 2003
- Critical Design Review (CDR) – June 2004
- Mission Operations Review (MOR) – April 2005
- Operations Readiness Review (ORR) – August 2006

The contractor shall present the appropriate MOC and operations-related information at these reviews, such as requirements, design, test approach, and operations plans and concepts. The contractor shall prepare and deliver the MOC and operations-related review package materials for each review as directed by the government.

5.1.2 Monthly Status Reviews

The contractor shall develop and present Monthly Status Reviews (MSR's) to the government, which shall include but not be limited to the items listed below. The MSR material shall be delivered to the government in hardcopy and softcopy formats. It is expected that all MSR's will be at the NASA Goddard facility.

1. Summary Status – Summarize the current contract and schedule status. Identify any anticipated changes in scheduled milestones. Provide current status of all critical path items and report schedule slack.
2. Major Accomplishments - Summarize achieved accomplishments versus planned accomplishments for the previous month and delineate planned accomplishments for the next month.
3. Current Problems/Risk Mitigation - Present a "Top Five" list of problems. State progress toward solving problems previously identified and discuss new problems that have been identified during the past month, including the schedule for resolution. State whether action by, or assistance from, Project management is required. Identify potential work around positions if a problem will have a significant impact on the on-time completion of the contract or on critical scheduled milestones. Discuss any risk mitigation actions that were implemented and status upcoming risk decision points.
4. Problem Avoidance - Recommend action by Project management that would assist in preventing major potential problems from developing.

5. Hardware/Software Acquisition Status - Discuss the status of planned hardware and software purchases and installations. Identify any MOC facilities-related issues that potentially affect the installation process.

5.2 Documentation

The contractor shall lead or support the development of a set of development and operations-related documents. The sections below describe these documents and indicate if the contractor is in a lead or support role.

The contractor shall deliver all documents to the government in hardcopy and softcopy forms: two bound copies for hardcopy, and electronic softcopies via a mutually agreed upon media (e.g., CD).

All documents delivered under this contract are subject to government approval and acceptance.

5.2.1 MOC Staffing Profile

The contractor shall develop a MOC Staffing Profile document that describes the staffing requirements over time for mission operations and sustaining engineering support for the first five years of the mission. The contractor can propose that this information be merged into another operations-related document if desired.

5.2.2 MOC inputs to the Integrated Mission Schedule

The contractor shall provide the appropriate inputs to the Integrated Mission Schedule maintained by the government. This input shall be delivered monthly or as otherwise needed by the government. The contractor shall updated status of all ongoing MOC development and operations-related activities.

5.2.3 MOC ICDs

The contractor shall prepare and deliver a variety of Interface Control Documents (ICD's) associated with the MOC. The ICD's include but are not limited to:

- MOC to Commercial Ground Station
- MOC to GCN
- MOC to SSC
- MOC to GBM IOC
- MOC to LAT IOC

The contractor shall support the development of other ICD's by other organizations as needed, such as the Spacecraft to MOC, SN to MOC, and Malindi Ground Station to MOC ICD's.

5.2.4 Flight Operations Manual

The contractor shall develop and deliver a Flight Operations Manual that describes all functions that can be accomplished with the MOC using the ground system. Constraints on operations and contingency operations are included.

5.2.5 Ground System Test Plan

The contractor shall support the development of the Ground System Test Plan, which describes the plan for testing the overall ground system.

5.2.6 MOC Development Documents

The contractor shall deliver a set of documents related to the development and test of the MOC, to include the following as a minimum:

- **MOC Development Plan** – defines the overall implementation approach, including the team organization, requirements verification process, development/release schedule, development metrics, and plans for documentation, configuration management, and software management.

- **MOC Configuration Management Plan** – defines the process and system to be used to manage and control the software and hardware configurations in the development and operations environments.

- **MOC System Requirements Document** – defines the Level 4 MOC functional and performance requirements.

- **MOC Design Specification** – describes the hardware and software design of the operational MOC system.

- **MOC Test Plan** – describes the approach to testing the MOC system and verifying that it meets the functional, performance and interface requirements.

5.2.7 Facilities Plan

The contractor shall support the development of a MOC Facilities Plan that describes the design, layout, implementation, and testing of the physical space of the MOC at NASA Goddard.

5.2.8 Mission Operations Readiness Plan

The contractor shall develop and deliver a Mission Operations Readiness Plan (MORP). The MORP shall describe the plan, approach and schedule for how operations readiness will be achieved prior to launch. This primarily includes the process for generating, validating and configuration managing the various operations products (e.g., command procedures, display pages, and data bases), and the plan for operations testing, simulations and rehearsals.

5.2.9 Operations Procedures

The contractor shall develop and validate the Operations Procedures needed to operate the spacecraft, instruments, and ground system. These shall include procedures for Launch & Early Orbit, nominal, and contingency operations.

5.2.10 Security Plans

The contractor shall support the development of Security Plans that include all documentation required to assure compliance with NPG 2810.1. These include the Contingency Plan, Risk Management Plan, and IT Security Plan.

5.2.11 Weekly Observatory Reports

The contractor shall provide a generalized on-orbit operations report that includes weekly status of each subsystem in the observatory and ground system. Anomalies of the previous week shall be described.

5.2.12 Monthly Observatory Reports

The contractor shall provide a detailed, monthly subsystem-by-subsystem report addressing the continuing on-orbit performance of the observatory. The contractor shall include a description of all open anomalies. The contractor shall maintain a historical record (electronic and hardcopy) of all anomalies encountered and documented during on-orbit operations.

5.2.13 Operations Agreement for Roles and Responsibilities

The contractor shall support the development of an Operations Agreement (OA) that will describe the overall roles and responsibilities of the primary operations teams. These include the government, contractor (flight operations team), spacecraft contractor, and instrument operations team. The government will lead the development of this OA.

5.2.14 MOC Operations Certification Plan

The contractor shall develop and deliver a MOC Operations Certification Plan that describes the method and procedures to be used to assure proper certification of all MOC operations personnel. The contractor can propose that this information be merged into another operations-related document if desired.

5.2.15 Operations Agreements with External Elements

The contractor shall develop and deliver operations agreements documents with MOC external elements as needed. These may include agreements with operations personnel associated with the SN, GN, SSC, LAT IOC, GBM IOC, or GCN.

5.2.16 Sustaining Engineering Plan

The contractor shall develop and deliver a Sustaining Engineering Plan that describes the approach to maintaining the observatory, MOC hardware and MOC software after launch. This document shall address the relationship with the spacecraft and instrument vendors for maintaining observatory health (e.g., analysis, trending and troubleshooting).

5.2.17 Documentation Summary

The following table provides a summary list of the deliverable documents described in this section, as well as targeted dates for final delivery. The contractor shall deliver one or more draft versions for review as appropriate. This table does not include items such as review packages, monthly reports, procedures, etc.

Implementation Related:	Targeted Completion Date
MOC Development Plan	Ground Data System (GDS) SRR + 3 months
MOC Configuration Management Plan	GDS CDR
MOC System Requirements Document	GDS CDR – 2 months
MOC Design Specification	GDS CDR + 3 months
MOC Test Plan	GDS CDR + 2 months
MOC / Ground Station ICD	GDS CDR – 1 month
MOC / SSC ICD	GDS CDR – 1 month
MOC / LAT IOC ICD	GDS CDR – 1 month
MOC / GBM IOC ICD	GDS CDR – 1 month
MOC / Gamma-Ray Coordinates Network (GCN) ICD	GDS CDR – 1 month
Operations Related:	
Mission Operations Readiness Plan	MOR + 1 month
Flight Operations Manual	ORR – 6 months
MOC Certification Plan	ORR – 8 months
Operations Agreements	Determined as needed
Sustaining Engineering Plan	ORR – 2 months

Table 1 – Deliverable Documents

6. SPECIAL REQUIREMENTS

6.1 Government Furnished Items

The government is responsible for delivering a variety of items and services that are needed to support the successful completion of the MOC implementation and achievement of operations readiness. These are described below.

6.1.1 Operations Facility

The government will provide the GLAST MOC facility, to be located at NASA Goddard. This will include power, lighting, furniture, wall clocks, access to an external time source, and other infrastructure items needed for operations support. This facility will be sized to support mission operations and system maintenance, as well as the government furnished hardware items (e.g., simulators).

6.1.2 Networks

The government will supply the space-to-ground communications services required to support the GLAST mission. The government will also supply access to external NASA ground networks for data and voice communications, except where it is determined advantageous to the government to have the contractor provide the network service. In these cases, the contractor shall acquire and maintain the network communications services under this contract. The contractor shall provide and maintain all equipment needed for data and voice communications within the MOC facility, such as voice communications systems and local area network routers.

6.1.3 Simulators

As part of the mission, the spacecraft manufacturer will be providing various spacecraft simulators that will be used to support ground system and operations product development and validation. These tools need to be evaluated and accepted by the government. The contractor shall assist the government in defining the requirements, evaluating and influencing the design, and validating and accepting the deliveries for each of the simulators.

6.1.3.1 MOC Training Simulator

The government will receive a MOC Training Simulator to be used for developing and verifying mission operations procedures, resolving anomalies, and training the mission operations team.

6.1.3.2 Spacecraft Telemetry and Command Simulator

The government will receive a Spacecraft Telemetry and Command Simulator (STCS) to be used for developing and verifying ground system interfaces. The fidelity of the STCS shall be sufficient to perform all necessary mission telemetry and command formatting and data flows.

6.1.3.3 Portable Spacecraft Simulator

The government will provide a Portable Spacecraft Simulator (PSS) to be used for developing and verifying ground system interfaces. This simulator augments the STCS, providing additional capabilities in the areas of SSR dumps/management, instrument simulation, and Burst Alert Message simulation.

6.1.4 Government Off-The-Shelf Software

The government will provide selected Government Off-The-Shelf Software (GOTS) products for use in the MOC. The government is responsible for ensuring that the GOTS products meet mission requirements, while the contractor is responsible for identifying any changes or fixes needed to the products, and integrating them into the overall MOC system. The products currently planned for delivery to the contractor by the government include the following:

- Integrated Test and Operations System (ITOS) – a command and control system used on the Swift mission, a mission similar to GLAST.
- Data Trending and Analysis System (DTAS) or equivalent – a trending system used on the Swift mission, a mission similar to GLAST.
- Spacecraft Emergency Response System (SERS) – a system that interacts with ITOS to provide spacecraft alarm management and operator paging, and provides a discrepancy/ anomaly management system capability.

The contractor is required to use the ITOS software for the monitor and control system, because this is the system used on the Swift mission. A previous GLAST MOC Trade Study concluded that using the Swift MOC/ITOS approach was the least risk approach for GLAST. For the other GOTS software listed above, the contractor may choose to use other approaches if these are shown to be beneficial to the government.

The government and contractor may decide during the development phase to incorporate other government-owned software products that have been deemed mutually beneficial to the government and contractor. These will be handled and negotiated on a case-by-case basis.

The government shall deliver any required GOTS products to the contractor at least two months prior to the delivery of the release that incorporates them. This will provide the contractor with ample time to integrate the GOTS products into the MOC release and perform the necessary testing.

6.1.5 Instrument Burst Processing Systems

The instrument teams plan to provide systems (hardware and software) to perform special processing with burst alert messages sent by the instruments and received by the MOC. These systems will be located in the MOC facility. The contractor shall be capable of operating these systems and do so when necessary, but will not be responsible for hardware or software maintenance, or system administration.

6.2 GMSEC Evaluation

The Goddard Mission Services Evolution Center (GMSEC) is a Project managed by the Information Systems Division (Code 580) and funded by the Code S and Y Enterprises, whose primary purpose is to improve the interoperability among traditional mission support ground system applications. This will be accomplished by developing a standard information bus based on current message passing and middleware technologies, and by adopting standard XML-based methods for defining data (particularly telemetry and command data). The effort may also include implementing some additional functionality, such as new application tools for trending analysis and event monitoring.

The contractor shall support the government in evaluating the applicability and benefit of the GMSEC architecture to the GLAST MOC. This shall include evaluating how the architecture might best be utilized in the MOC design, and determining the associated schedule and cost implications. This effort shall be completed by the Ground System CDR.

6.3 Science Planning Software Support

The Science Support Center (SSC) will provide the science observation planning support capabilities for the GLAST mission. The SSC will be evaluating various tools to meet this requirement, and one under consideration is the Timeline Assembler, Keyword Oriented (TAKO) tool. TAKO will be used on Swift, and since Swift and GLAST will perform similar science and have similar observation planning requirements, it is a good candidate for evaluation. The contractor shall support this effort with the SSC team to help evaluate the implications of reusing TAKO for GLAST, including determining the types and extent of changes that would be needed to meet GLAST requirements and providing demonstrations of the software. This support shall be completed by the Ground System PDR.

6.4 General System Engineering/Study Pool Support

The contractor shall perform special/studies/task assignments relating to the development, implementation, characterization, qualification, and operation of the GLAST MOC, as authorized by the Government and in accordance with the contract.

7. LOCATION OF SERVICES

The following lists the locations of the major facilities relevant to the implementation of the MOC, preparation for mission operations, and on-orbit mission operations support.

- MOC Development – Contractor facility
- MOC Facility – NASA GSFC, Greenbelt, MD
- SSC – NASA GSFC, Greenbelt, MD
- GBM IOC – NASA Marshall Space Flight Center, MSFC, AL
- LAT IOC – Palo Alto, CA
- Spacecraft Contractor – Gilbert, AZ
- Malindi Ground Station – Kenya Africa
- Italian Space Agency (ASI) Italy
- Universal Space Network – South Point, Hawaii